(54) **WIRELESS NETWORK ROAMING TIMER METHOD AND APPARATUS**

ROAMING-TIMER-VERFAHREN UND -VORRICHTUNG FÜR EIN DRAHTLOSES NETZWERK

PROCEDE ET APPAREIL CHRONOMETREUR ITINERANT DANS UN RESEAU SANS FIL

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Description

Field

[0001] The present invention relates generally to computer networks, and more specifically to wireless networks.

Background

[0002] Wireless networks typically include mobile stations and access points. A mobile station may "associate" with an access point (referred to herein as the "current access point") to communicate with other devices on the network. Mobile stations may move about while access points are typically stationary. If a mobile station moves around in an area covered by multiple access points, the mobile station may "disassociate" from the current access point and associate with another. The process of disassociation and association may be repeated any number of times, as the mobile station moves about.

[0003] In order to decide whether or not to disassociate from the current access point or associate with a different access point, a mobile station may periodically communicate with a variety of access points, including access points other than the current access point. When a mobile station communicates with access points other than the current access point, the data throughput between the mobile station and the current access point may suffer.

[0004] US 6 062 598 discloses a method for predicting the location of a mobile station in a mobile communications network comprising determining a location of a mobile unit and estimating a future location of the mobile unit based on signal strengths between base stations and the mobile station. Based on the predicted future location, a handoff decision is made. After deciding that a handoff should occur in the future, the "...time ...t=Ti2 ... is determined".

[0005] LEE D-J ET AL: "On Optimum Timer Value of Area and Timer-based Location Registration Scheme" IEEE Communications Letters, IEEE Service Center, Piscataway, US, vol. 5, no. 4, April 2001 (2001-04), pages 148-150, discloses a location registration scheme to update the location of a mobile station (MS) that moves around wherein the MS performs location update when it enters a new location area and updates the location information based on location update timer during residence within the same location area and wherein the optimum timer value of the MS based on the speed and call arrival rate of the MS for area and timer-based location registration method. When a call arrives for the MS, paging is performed using the location information. If the location information is accurate, less paging resources are utilized to complete the call.

Brief Description of the Drawings

[0006]

Figure 1 shows a diagram of a wireless network;
Figures 2 and 3 show flowcharts in accordance with various embodiments of the present invention;
Figure 4 shows a plot with various received signal strength indicator thresholds; and
Figure 5 shows a system diagram in accordance with various embodiments of the present invention.

Description of Embodiments

[0007] In the following detailed description, reference is made to the accompanying drawings that show, by way of illustration, specific embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. It is to be understood that the various embodiments of the invention, although different, are not necessarily mutually exclusive. For example, a particular feature, structure, or characteristic described herein in connection with one embodiment may be implemented within other embodiments without departing from the scope of the invention. In addition, it is to be understood that the location or arrangement of individual elements within each disclosed embodiment may be modified without departing from the scope of the invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims, appropriately interpreted, along with the full range of equivalents to which the claims are entitled. In the drawings, like numerals refer to the same or similar functionality throughout the several views.

[0008] Figure 1 shows a diagram of a wireless network. Wireless network 100 includes mobile station 102 and access points (AP) 110, 120, and 130. In some embodiments, wireless network 100 is a wireless local area network (WLAN). For example, access points 110, 120, and 130, and mobile station 102 may operate in compliance with a wireless network standard such as ANSI/IEEE Std. 802.11, 1999 Edition, although this is not a limitation of the present invention.

[0009] Mobile station 102 is shown communicating with access point 110 using signal 112, access point 120 using signal 122, and access point 130 using signal 132. Mobile station 102 may associate with one of the access points for data communications, and may also communicate with other access points to decide if it should end the current association and associate with another access point. For example, mobile station 102 may be associated with access point 110. When a current association exists between mobile station 102 and access point 110, signal 112 allows data to be communicated between mobile station 102 and access point 110.

[0010] Mobile station 102 may periodically "roam," or "attempt to roam." As used herein, the terms "roam" and "attempt to roam" refer to the actions taken by a mobile station when deciding whether to end a current association ("disassociate") and make a new association with

a different access point. In some instances, roaming occurs when a mobile station performs a scan of available access points and decides to disassociate with the current access point and re-associate with a different access point. In other instances, an attempt to roam occurs when a mobile station performs a scan of available access points, and does not disassociate with the current access point. This may occur when the mobile station scans to see if a "better" access point is available, and decides to maintain the current association rather than disassociate with the current access point.

[0011] Roaming, or attempting to roam, may reduce the data throughput of the current association. For example, if mobile station 102 attempts to roam to check the availability of access points 120 and 130, the data throughput of the current association with access point 110 may be reduced.

[0012] Mobile station 102 includes roaming timer 104. A roaming timer, as defined herein, is a timer that may be used to put off an attempt to roam based on various criteria. For example, if the current association is perceived to be of "high quality," roaming timer 104 may be set to a relatively large value, and any roaming attempts by mobile station 102 may be delayed, or "put off," in time until the timer expires. In some embodiments, the timer may be repeatedly set or reset to continually delay any attempts to roam, or to force an attempt to roam immediately. Further, the roaming timer may be set to any value based on any criteria. The type or amount of criteria used to the set the timer should not be considered a limitation of the present invention.

[0013] Roaming timer 104 may be implemented using any of many different mechanisms. For example, roaming timer 104 may be a hardware timer or a software timer. In some embodiments, multiple hardware timers are utilized, where each is set to either the same or different values. In other embodiments, multiple software timers are utilized, where each is set to either the same or different values. A roaming attempt may occur when one of the multiple timers times out, or when all of the multiple timers times out.

[0014] The perceived quality of a current association may be defined by any parameter, metric, or combination of parameters or metrics. Various embodiments using different parameters and metrics are described below with reference to the remaining figures.

[0015] Figure 2 shows a flowchart in accordance with various embodiments of the present invention. In some embodiments, method 200 may be used to decide when to attempt to roam in a wireless network. In some embodiments, method 200, or portions thereof, is performed by a wireless network interface, a processor, or an electronic system, embodiments of which are shown in the various figures. Method 200 is not limited by the particular type of apparatus, software element, or person performing the method. The various actions in method 200 may be performed in the order presented, or may be performed in a different order. Further, in some embodi-

ments, some actions listed in Figure 2 are omitted from method 200.

[0016] Method 200 is shown beginning at block 210 in which a first metric is compared to a first threshold; and in block 220, a timer is conditionally set to a first value. The timer referred to in block 220 operates as a roaming timer, such as roaming timer 104 (Figure 1). Rather than only attempting to roam at periodic intervals, the device performing method 200 may attempt to roam at various intervals based, at least in part, on the values to which the timer is set.

[0017] Utilizing a roaming timer to put off a roaming attempt may be useful in many different operational scenarios. For example, if during a current association with an access point, a mobile station enjoys a "high quality" connection, periodic attempts to roam may not be the most efficient use of the mobile station's resources. On the other hand, if a mobile station has a lower quality connection, the interval between roaming attempts may be modified to make more efficient use of the mobile station's resources.

[0018] In block 230, a second metric is compared to a second threshold, and in block 240, the timer is conditionally set to a second value. Various embodiments of the present invention are not limited to two metrics, two thresholds, and two timer values as shown in Figure 2. For example, in some embodiments, many more than two metrics are utilized. Further, in some embodiments, a single metric is used, and the single metric is compared against multiple thresholds. The result of the comparison with multiple thresholds may result in setting a roaming timer with one of many different possible timer values.

[0019] In block 250, an attempt to roam is made when the timer expires. In some embodiments, the timer runs in the "background." For example, in embodiments that include a hardware timer, the hardware may be adapted to decrement a counter every clock cycle or every N clock cycles. The counter may perform as a roaming timer when loaded with a timer value, and the counter is decremented in the background. In other embodiments that include a hardware timer, the counter is only decremented when enabled, and various method embodiments of the present invention not only set the timer, but also enable and disable the timer. When the timer times out, the roaming attempt may be initiated in one of many different ways. For example, the hardware timer may cause a processor interrupt, or may set a bit in a status register. The present invention is not limited in this respect.

[0020] In embodiments that include a software timer, the software timer may be implemented as a software counter that is decremented in the background. For example, a software routine may be scheduled to run every second, or every 100 milliseconds, and each time the software routine runs, it may decrement the counter that functions as the roaming timer. Further, the software counter may be enabled or disabled in support of the operation of the roaming timer. The interval between successive decrement operations of the counter is not a lim-

itation of the present invention.

[0021] In some embodiments, method 200 may be performed periodically. For example, method 200 may run every second or every ten seconds in a mobile station, such as mobile station 102 (Figure 1). As a result, roaming attempts may be put off indefinitely, or may be performed at intervals defined, at least in part, by the timer values.

[0022] Figure 3 shows a flowchart in accordance with various embodiments of the present invention. In some embodiments, method 300 may be used to decide when to attempt to roam in a wireless network. In some embodiments, method 300, or portions thereof, is performed by a wireless network interface, a processor, or an electronic system, embodiments of which are shown in the various figures. Method 300 is not limited by the particular type of apparatus, software element, or person performing the method. The various actions in method 300 may be performed in the order presented, or may be performed in a different order. Further, in some embodiments, some actions listed in Figure 3 are omitted from method 300.

[0023] Method 300 is shown beginning at block 305 in which a first metric is compared to a threshold. The metric includes a determination of how many "beacons" have been missed. In some embodiments, a beacon is a packet or frame periodically transmitted by an access point. If many beacons have been missed by a mobile station, this may be indicative of a poor quality connection between the mobile station and the access point. As shown in Figure 3, if many beacons have been missed, an attempt to roam may be performed at 310.

[0024] The attempt to roam at 310 may be performed by resetting a roaming timer, or by performing an attempt to roam regardless of the state of the roaming timer. The number of missed beacons used as a threshold in block 305 may be set to any threshold. In some embodiments, if more than 50% of beacons are missed, an attempt to roam is performed at block 310. In other embodiments, if more than 60% of beacons are missed, an attempt to roam is performed at block 310. The particular threshold used in block 305 is not a limitation of the present invention.

[0025] At 315, a percentage of "retries" is checked, and if it is not high, then method 200 ends with a determination to not attempt roaming at block 320. A "retry" corresponds to a packet or frame that is retransmitted because of a previously unsuccessful attempt at transmission. The percentage of retries represents a metric that can be either gathered or calculated, and the number to which the percentage is compared represents a threshold. The actual percentage used as a threshold is not a limitation of the present invention.

[0026] The remaining decision blocks (325, 335, and 345) compare a metric against a threshold, and conditionally enter one of four states (330, 340, 350, or 360) depending on the outcome of the decisions. Although three decision blocks and four states are shown, any

number of decision blocks and states may be implemented without departing from the scope of the present invention.

[0027] Decision block 325 compares a current data rate to a threshold. In some embodiments, the threshold is the lowest data rate available. For example, in some embodiments, the mobile station will reduce the data rate as the distance to the access point increases, or as the received signal strength decreases. If the current data rate corresponds to the lowest rate available, then if the signal degrades further, the mobile station may be forced to disassociate. If the current rate is low, then method 300 enters STATE A (block 330) where the roaming timer is set to 10 seconds.

[0028] Block 330 is referred to as a "state" in part because, if in subsequent invocations of method 300, STATE A is re-entered, then the timer is not necessarily set to 10 seconds again. For example, assuming that method 300 is performed once a second, and each time it is performed block 330 is reached, the first time block 330 is reached, STATE A will be entered, and the roaming timer will be set to 10 seconds. The second time block 330 is reached, the roaming timer will not be set, because STATE A has remained the active state. In this example, method 300 will be performed 10 times, block 330 will be reached each time, the roaming timer will expire, and an attempt to roam will be performed.

[0029] If, in method 300, decision block 335 is reached, an average received signal strength indicator (RSSI) is compared against a threshold. In block 335, the RSSI is the metric, and the "current rate threshold" is the threshold to which the metric is compared. If the average RSSI is less than the current rate threshold, then block 340 is reached, and if the current state is not STATE B, STATE B is entered, and the roaming timer is set to two minutes. If block 340 was reached the last time that method 300 was performed, then the current state remains STATE B, and the timer is not necessarily set. If block 340 is reached each time method 300 is performed over a two minute period, the timer will expire, and an attempt to roam will be performed.

[0030] An example of a "current rate threshold" is shown in Figure 4 at 410. As shown in Figure 4, the current rate threshold may vary as a function of the current rate. Four current rate threshold values are shown in Figure 4, each corresponding to a different rate. Any number of current rate thresholds may exist without departing from the scope of the present invention. In some embodiments, the thresholds are different as shown in Figure 4, and in other embodiments, the thresholds are the same.

[0031] Referring now back to Figure 3, if decision block 345 is reached, an average received signal strength indicator (RSSI) is compared against a second threshold. In block 345, the RSSI is the metric, and the "good threshold" is the threshold to which the metric is compared. If the average RSSI is less than the good threshold, then block 350 is reached, and if the current state is not STATE

C, STATE C is entered, and the roaming timer is set to four minutes. If block 350 was reached the last time that method 300 was performed, then the current state remains STATE C, and the timer is not necessarily set. If block 350 is reached each time method 300 is performed over a four minute period, the timer will expire, and an attempt to roam will be performed.

[0032] If in block 345, the average RSSI is not below the good threshold, then block 360 is reached, and if the current state is not STATE D, STATE D is entered, and the roaming timer is set to fifteen minutes. If block 360 was reached the last time that method 300 was performed, then the current state remains STATE D, and the timer is not necessarily set. If block 360 is reached each time method 300 is performed over a fifteen minute period, the timer will expire, and an attempt to roam will be performed.

[0033] An example of a "good threshold" is shown in Figure 4 at 420. As shown in Figure 4, the good threshold does not vary as a function of the current rate, but this is not a limitation of the present invention. For example, in some embodiments the good threshold may vary as a function of current rate, similar to the current rate threshold shown at 410.

[0034] In some embodiments, method 300 is performed periodically within a mobile station such as mobile station 102 (Figure 1). For example, method 300 may be performed once a second, or once every ten seconds. In some embodiments, each time method 300 is performed, the roaming timer is either set to a value or decremented. In other embodiments, the roaming timer is decremented in the background, and method 300 either sets the roaming timer, or performs no operation on the roaming timer.

[0035] Method 300 allows a mobile station to measure a "perceived quality" of a current connection. The perceived quality of the connection is based on various metrics as shown in method 300. In some embodiments, the roaming timer is set to a relatively high value when the perceived quality is high. Also in some embodiments, the roaming timer is set to a relatively low value when the perceived quality is lower.

[0036] Figure 4 shows a plot with various received signal strength indicator thresholds. The vertical axis corresponds to thresholds for comparison against the received signal strength indicator (RSSI). The horizontal axis represents data rates. As shown in Figure 4, the current rate threshold is a function of the current data rate, and the good threshold is constant. In some embodiments, more than two types of thresholds are utilized, and in some embodiments, more than one threshold is a function of data rate.

[0037] Figure 5 shows a system diagram in accordance with various embodiments of the present invention. Electronic system 500 includes antenna 510, radio interface 520, physical layer (PHY) 530, media access control layer (MAC) 540, processor 560, roaming timer 550, and memory 570. Electronic system 500 also includes host

processor 580 and host memory 590. In operation, system 500 sends and receives signals using antenna 510, and the signals are processed by the various elements shown in Figure 5. Antenna 510 may be a directional antenna or an omni-directional antenna. As used herein, the term omni-directional antenna refers to any antenna having a substantially uniform pattern in at least one plane. For example, in some embodiments, antenna 510 may be an omni-directional antenna such as a dipole antenna, or a quarter wave antenna. Also for example, in some embodiments, antenna 510 may be a directional antenna such as a parabolic dish antenna or a Yagi antenna.

[0038] Host processor 580 is coupled to processor 560 by bus 565. The blocks shown to the left of bus 565 may be an apparatus such as a wireless network interface, and the blocks shown to the right of bus 565 may be an apparatus or system such as a laptop computer. The wireless interface may be on a card that plugs into the laptop computer, or may be a wireless interface that is integral with the computer. In some embodiment, bus 565 represents a communications bus such as a peripheral component interconnect (PCI) bus, however this is not a limitation of the present invention.

[0039] Radio interface 520 may include circuitry to support the transmission and reception of radio frequency (RF) signals. For example, in some embodiments, radio interface 520 includes an RF receiver to receive signals and perform "front end" processing such as low noise amplification (LNA), filtering, frequency conversion or the like. Also for example, in some embodiments, radio interface 520 includes circuits to support frequency up-conversion, and an RF transmitter. The invention is not limited by the contents or function of radio interface 520.

[0040] Physical layer (PHY) 530 may be any suitable physical layer implementation. For example, PHY 530 may be a circuit block that implements a physical layer that complies with the IEEE 802.11 standard or other standard. Examples include, but are not limited to, direct sequence spread spectrum (DSSS), frequency hopping spread spectrum (FHSS), and orthogonal frequency division multiplexing (OFDM). Media access control layer (MAC) 540 may be any suitable media access control layer implementation. For example, MAC 540 may be implemented in software, or hardware or any combination thereof. In some embodiments, MAC 540 may be implemented in software that is partially executed by processor 560 and partially executed by host processor 580.

[0041] Roaming timer 550 may be a timer utilized to put off a decision to roam, such as roaming timer 104 (Figure 1). Roaming timer 550 may be implemented in hardware or software or any combination. In some embodiments, roaming timer 550 is set to various values, and when the timer expires, an attempt to roam is performed. For example, methods such as method 200 (Figure 2) and method 300 (Figure 3) may be used to compare metrics to thresholds and conditionally set roaming

timer 550. In some embodiments, roaming timer 550 may be coupled to (or implemented by) processor 560. In other embodiments, roaming timer 550 may be coupled to (or implemented by) host processor 580.

[0042] Processor 560 may be a processor that sets roaming timer 550 based, at least in part, on comparisons between metrics and thresholds. For example, processor 560 may perform methods such as method 200 (Figure 2) or method 300 (Figure 3). Processor 560 represents any type of processor, including but not limited to, a microprocessor, a digital signal processor, a microcontroller, or the like. In some embodiments, processor 560 does not exist, and dedicated digital logic or other hardware is coupled to roaming timer 550. In these embodiments, the dedicated digital logic or other hardware may set roaming timer 550 based, at least in part, on comparisons between metrics and thresholds.

[0043] Memory 570 represents an article that includes a machine readable medium. For example, memory 570 represents a random access memory (RAM), dynamic random access memory (DRAM), static random access memory (SRAM), read only memory (ROM), flash memory, or any other type of article that includes a medium readable by processor 560. Memory 570 can store instructions for performing the execution of the various method embodiments of the present invention.

[0044] Host processor 580 may be any processor capable of communication with processor 560 over bus 565. Host processor 580 represents any type of processor, including but not limited to, a microprocessor, a personal computer, a workstation, or the like. In some embodiments, host processor 580 may set a roaming timer. For example, host processor 580 may implement MAC 540 or a portion of MAC 540 in a software driver or other software. A MAC (or a portion thereof) implemented in processor 580 may include one or more roaming timers as discussed herein.

[0045] Host memory 590 represents an article that includes a machine readable medium. For example, host memory 590 represents any one or more of the following: a hard disk, a floppy disk, random access memory (RAM), dynamic random access memory (DRAM), static random access memory (SRAM), read only memory (ROM), flash memory, CDROM, or any other type of article that includes a medium readable by host processor 580.

[0046] Systems represented by the various foregoing figures can be of any type. Examples of represented systems include computers (e.g., desktops, laptops, handhelds, servers, tablets, web appliances, routers, etc.), wireless communications devices (e.g., cellular phones, cordless phones, pagers, personal digital assistants, etc.), computer-related peripherals (e.g., printers, scanners, monitors, etc.), entertainment devices (e.g., televisions, radios, stereos, tape and compact disc players, video cassette recorders, camcorders, digital cameras, MP3 (Motion Picture Experts Group, Audio Layer 3) players, video games, watches, etc.), and the like.

[0047] Roaming timers, processors, wireless network interfaces, and other embodiments of the present invention can be implemented in many ways. In some embodiments, they are implemented in electronics as part of mobile stations for use in wireless networks. In some embodiments, design descriptions of the various embodiments of the present invention are included in libraries that enable designers to include them in custom or semi-custom designs. For example, any of the disclosed embodiments can be implemented in a synthesizable hardware design language, such as VHDL or Verilog, and distributed to designers for inclusion in standard cell designs, gate arrays, or the like. Likewise, any embodiment of the present invention can also be represented as a hard macro targeted to a specific manufacturing process.

[0048] Although the present invention has been described in conjunction with certain embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art readily understand. Such modifications and variations are considered to be within the scope of the invention and the appended claims.

Claims

1. A method in a wireless network comprising access points (110,120, 130) and at least one wireless network client (102) **characterised by** the steps of:

   comparing a first metric to a first threshold of the current association between the wireless network client (102) and one of the access points (110, 120, 130); and
   in response, setting a timer (104) within the wireless network client (102) to a first value; and attempting to roam by the wireless network client (102) when the timer (104) expires.

2. The method of claim 1 wherein the first metric comprises a received signal strength indicator.

3. The method of claim 1 wherein the first metric comprises a current data rate.

4. The method of claim 1 wherein the first metric comprises a number of packet retries.

5. The method of claim 1 further comprising comparing a plurality of metrics against a plurality of thresholds, and setting the timer (104) in response.

6. The method of claim 1 wherein the metric comprises a received signal strength indicator, and the threshold is dependent on the current data rate.

7. The method of claim 1 further comprising setting the timer (104) to a value to delay a roaming attempt by

a mobile station (102) in the wireless network, wherein the mobile station (102) attempts to roam after the timer (104) expires.

8. The method of claim 7 wherein setting the timer (104) comprises comparing at least one metric to at least one threshold, and setting the timer (104) in response.

9. The method of claim 7 wherein the value to which the timer (104) is set is influenced by a perceived quality of a current association.

10. The method of claim 9 wherein when the perceived quality of the current association is relatively low, the timer (104) is set to a value that is relatively low.

11. The method of claim 9 wherein when the perceived quality of the current association is relatively high, the timer (104) is set to a value that is relatively high.

12. The method of claim 7 wherein setting the timer (104) comprises setting a hardware timer.

13. The method of claim 7 wherein setting the timer (104) comprises setting a software timer.

14. The method of claim 1 further comprising:

   comparing a second metric to a second threshold of the current association and conditionally setting the timer (104) to a second value.

15. The method of claim 14 wherein the first metric comprises a data rate.

16. The method of claim 15 wherein the first threshold corresponds to the lowest possible data rate.

17. The method of claim 15 wherein the second metric comprises a received signal strength indicator.

18. The method of claim 17 wherein the second threshold is dependent on the current data rate.

19. The method of claim 17 wherein the second value is larger than the first value.

20. The method of claim 14 further comprising comparing a percentage of missed beacons to a threshold, and conditionally attempting to roam in response.

21. An apparatus including a medium adapted to hold machine-accessible instructions that when accessed result in a machine performing the method steps according to any one of claims 1-20.

22. The apparatus of claim 21, further comprising:

a radio interface (510) to interact with the wireless network; and
a processor (560) coupled to the radio interface (510), wherein the processor (560) is adapted to set the timer based on a perceived quality of a current association, and further adapted to attempt roaming when the timer (104) expires.

23. The apparatus of claim 22 wherein the timer (104) is at least partially implemented in hardware.

24. The apparatus of claim 22 wherein the timer (104) is at least partially implemented in software.

25. An electronic system (500) comprising the apparatus of any one of claims 21-24, further comprising:

   an omni-directional antenna (510);

wherein the radio interface (520) is coupled to the omni-directional antenna(510)

Patentansprüche

1. Verfahren in einem Drahtlosnetzwerk, das Zugangspunkte (110, 120, 130) und mindestens einen Drahtlosnetzwerk-Client (102) umfasst, **gekennzeichnet durch** folgende Schritte:

   Vergleichen einer ersten Metrik mit einem ersten Schwellwert der aktuellen Verbindung zwischen dem Drahtlosnetzwerk-Client (102) und einem der Zugangspunkte (110, 120, 130); und, als Reaktion darauf, Einstellen eines Timers (104) in dem Drahtlosnetzwerk-Client (102) auf einen ersten Wert; und
   Versuchen zu roamen **durch** den Drahtlosnetzwerk-Client (102), wenn der Timer (104) abläuft.

2. Verfahren nach Anspruch 1, wobei die erste Metrik einen Empfangssignalstärkeindikator umfasst.

3. Verfahren nach Anspruch 1, wobei die erste Metrik eine aktuelle Datenrate umfasst.

4. Verfahren nach Anspruch 1, wobei die erste Metrik eine Anzahl von Paketwiederholungen umfasst.

5. Verfahren nach Anspruch 1, ferner umfassend das Vergleichen einer Mehrzahl von Metriken mit einer Mehrzahl von Schwellwerten und das Einstellen des Timers (104) als Reaktion darauf.

6. Verfahren nach Anspruch 1, wobei die Metrik einen Empfangssignalstärkeindikator umfasst und der Schwellwert von der aktuellen Datenrate abhängig ist.

7. Verfahren nach Anspruch 1, ferner umfassend das Einstellen des Timers (104) auf einen Wert, um einen Roamingversuch durch eine mobile Station (102) in dem Drahtlosnetzwerk zu verzögern, wobei die mobile Station (102) versucht zu roamen, nachdem der Timer (104) abläuft.

8. Verfahren nach Anspruch 7, wobei das Einstellen des Timers (104) das Vergleichen von mindestens einer Metrik mit mindestens einem Schwellwert und das Einstellen des Timers (104) als Reaktion darauf umfasst.

9. Verfahren nach Anspruch 7, wobei der Wert, auf den der Timer (104) eingestellt wird, durch eine wahrgenommene Qualität einer aktuellen Verbindung beeinflusst wird.

10. Verfahren nach Anspruch 9, wobei, wenn die wahrgenommene Qualität der aktuellen Verbindung relativ niedrig ist, der Timer (104) auf einen Wert eingestellt wird, der relativ niedrig ist.

11. Verfahren nach Anspruch 9, wobei, wenn die wahrgenommene Qualität der aktuellen Verbindung relativ hoch ist, der Timer (104) auf einen Wert eingestellt wird, der relativ hoch ist.

12. Verfahren nach Anspruch 7, wobei das Einstellen des Timers (104) das Einstellen eines Hardware-Timers umfasst.

13. Verfahren nach Anspruch 7, wobei das Einstellen des Timers (104) das Einstellen eines Software-Timers umfasst.

14. Verfahren nach Anspruch 1, ferner umfassend:

Vergleichen einer zweiten Metrik mit einem zweiten Schwellwert der aktuellen Verbindung und bedingtes Einstellen des Timers (104) auf einen zweiten Wert.

15. Verfahren nach Anspruch 14, wobei die erste Metrik eine Datenrate umfasst.

16. Verfahren nach Anspruch 15, wobei der erste Schwellwert der niedrigstmöglichen Datenrate entspricht.

17. Verfahren nach Anspruch 15, wobei die zweite Metrik einen Empfangssignalstärkeindikator umfasst.

18. Verfahren nach Anspruch 17, wobei der zweite Schwellwert von der aktuellen Datenrate abhängig ist.

19. Verfahren nach Anspruch 17, wobei der zweite Wert

größer als der erste Wert ist.

20. Verfahren nach Anspruch 14, ferner umfassend das Vergleichen eines Prozentsatzes von "verpassten Beacons" mit einem Schwellwert und das bedingte Versuchen zu roamen als Reaktion darauf.

21. Vorrichtung, umfassend ein Medium, das ausgebildet ist, um für Maschinen zugängliche Anweisungen aufzunehmen, welche, wenn darauf zugegriffen wird, dazu führen, dass eine Maschine die Verfahrensschritte gemäß einem beliebigen der Ansprüche 1-20 ausführt.

22. Vorrichtung nach Anspruch 21, ferner umfassend:

eine Funkschnittstelle (510), um mit dem Drahtlosnetzwerk zusammenzuwirken; und
einen Prozessor (560), der mit der Funkschnittstelle (510) gekoppelt ist, wobei der Prozessor (560) ausgebildet ist, um den Timer auf der Grundlage einer wahrgenommenen Qualität einer aktuellen Verbindung einzustellen, und ferner ausgebildet ist, um Roaming zu versuchen, wenn der Timer (104) abläuft.

23. Vorrichtung nach Anspruch 22, wobei der Timer (104) mindestens zum Teil als Hardware implementiert ist.

24. Vorrichtung nach Anspruch 22, wobei der Timer (104) mindestens zum Teil als Software implementiert ist.

25. Elektronisches System (500), umfassend die Vorrichtung nach einem beliebigen der Ansprüche 21-24, ferner umfassend:

eine Rundstrahlantenne (510);

wobei die Funkschnittstelle (520) mit der Rundstrahlantenne (510) gekoppelt ist.

Revendications

1. Procédé dans un réseau sans fil comprenant des points d'accès (110, 120, 130) et au moins un client de réseau sans fil (102) **caractérisé par** les étapes de :

comparaison d'une première mesure à un premier seuil de l'association actuelle entre le client de réseau sans fil (102) et un des points d'accès (110, 120, 130) ; et
en réponse, réglage d'une temporisation (104) dans le client de réseau sans fil (102) à une première valeur ; et

tentative d'itinérance par le client de réseau sans fil (102) lorsque la temporisation (104) expire.

2. Procédé selon la revendication 1, dans lequel la première mesure comprend un indicateur de puissance de signal reçu.

3. Procédé selon la revendication 1, dans lequel la première mesure comprend un débit de données actuelles.

4. Procédé selon la revendication 1, dans lequel la première mesure comprend un nombre de réessais de paquet.

5. Procédé selon la revendication 1, comprenant en outre la comparaison d'une pluralité de mesures par rapport à une pluralité de seuils, et réglage de la température de la temporisation (104) en réponse.

6. Procédé selon la revendication 1 où la mesure comprend un indicateur de puissance de signal reçu, et le seuil est dépendant du débit de données actuelles.

7. Procédé selon la revendication 1, comprenant en outre le réglage de la temporisation (104) à une valeur pour retarder une tentative d'itinérance par une station mobile (102) dans le réseau sans fil, dans lequel la station mobile (102) tente l'itinérance après que la temporisation (104) expire.

8. Procédé selon la revendication 7, dans lequel le réglage de la temporisation (104) comprend la comparaison d'au moins une mesure à au moins un seuil, et réglage de la temporisation (104) en réponse.

9. Procédé selon la revendication 7, dans lequel la valeur à laquelle l'horloge (104) est réglée est influencée par une qualité perçue d'une association actuelle.

10. Procédé selon la revendication 9, dans lequel la qualité perçue de l'association actuelle est relativement faible, la temporisation (104) est réglée à une valeur qui est relativement lente.

11. Procédé selon la revendication 9, dans lequel lorsque la qualité perçue de l'association actuelle est relativement élevée, la temporisation (104) est réglée à une valeur qui est relativement élevée.

12. Procédé selon la revendication 7, dans lequel le réglage de la temporisation (104) comprend le réglage d'une temporisation matérielle.

13. Procédé selon la revendication 7, dans lequel le réglage de la temporisation (104) comprend le réglage d'une temporisation logicielle.

14. Procédé selon la revendication 1, comprenant en outre :

     la comparaison d'une seconde mesure à un second seuil de l'association actuelle et le réglage conditionnellement de la temporisation (104) à une seconde valeur.

15. Procédé selon la revendication 14, dans lequel la première mesure comprend un débit de données.

16. Procédé selon la revendication 15, dans lequel le premier seuil correspond au débit de données aussi faible que possible.

17. Procédé selon la revendication 15, dans lequel la seconde mesure comprend un indicateur de puissance de signal reçu.

18. Procédé selon la revendication 17, dans lequel le second seuil est dépendant du débit de données actuelles.

19. Procédé selon la revendication 17, dans lequel la seconde valeur est plus grande que la première valeur.

20. Procédé selon la revendication 14, comprenant en outre la comparaison d'un pourcentage de balises loupées à un seuil, et tentative conditionnellement d'itinérance en réponse.

21. Appareil comprenant un support adapté pour maintenir des instructions accessibles par machine qui lorsqu'elles sont accédées résultent en une réalisation par machine des étapes du procédé selon l'une quelconque des revendications 1 à 20.

22. Procédé selon la revendication 21, comprenant en outre :

     une interface radio (510) pour interagir avec le réseau sans fil ; et
     un processeur (160) couplé à l'interface radio (510), dans lequel le processeur (560) est adapté pour régler la temporisation sur la base d'une qualité perçue d'une association actuelle, et adapté en outre pour tenter l'itinérance lorsque la temporisation (104) expire.

23. Appareil selon la revendication 22, dans lequel la temporisation (104) est au moins partiellement implémentée dans du matériel.

24. Appareil selon la revendication 22, dans lequel la temporisation (104) est au moins partiellement im-

plémentée dans du logiciel.

25. Système électronique (500) comprenant l'appareil d'une quelconque des revendications 21 à 24, comprenant en outre :

    une antenne omnidirectionnelle (510) ;

où l'interface radio (520) est couplée à l'antenne omnidirectionnelle (510).

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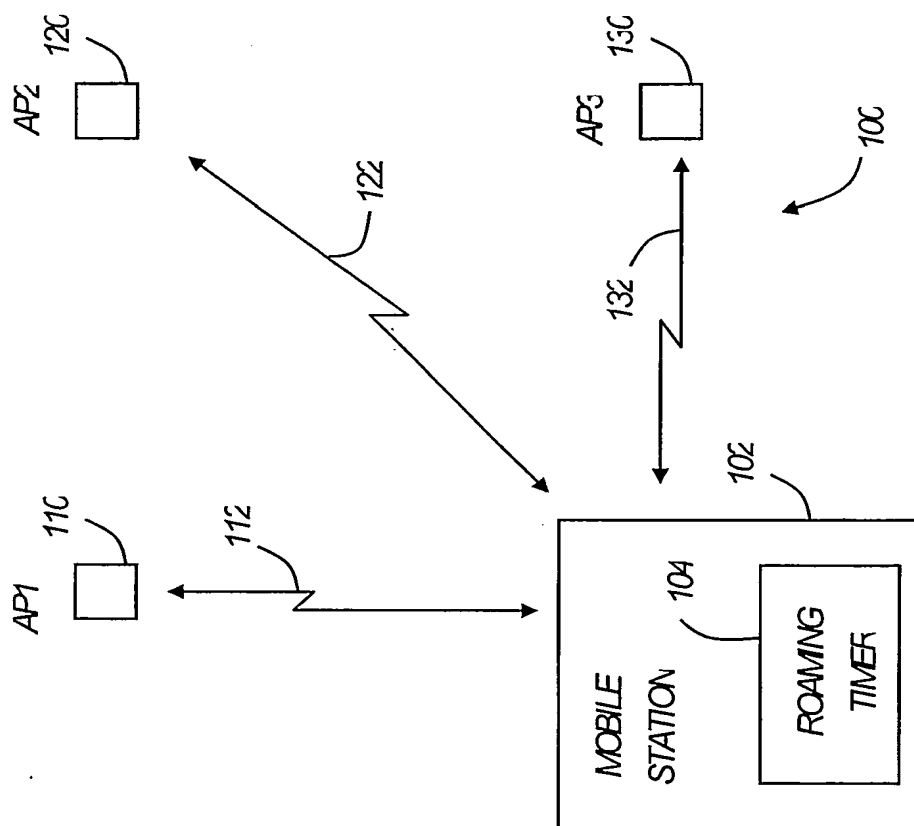*10*

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FIG. 1

COMPARE A FIRST METRIC TO A FIRST THRESHOLD —210

CONDITIONALLY SET A TIMER TO A FIRST VALUE —220

COMPARE A SECOND METRIC TO A SECOND THRESHOLD —230

CONDITIONALLY SET A TIMER TO A SECOND VALUE —240

ATTEMPT TO ROAM WHEN THE TIMER EXPIRES —250
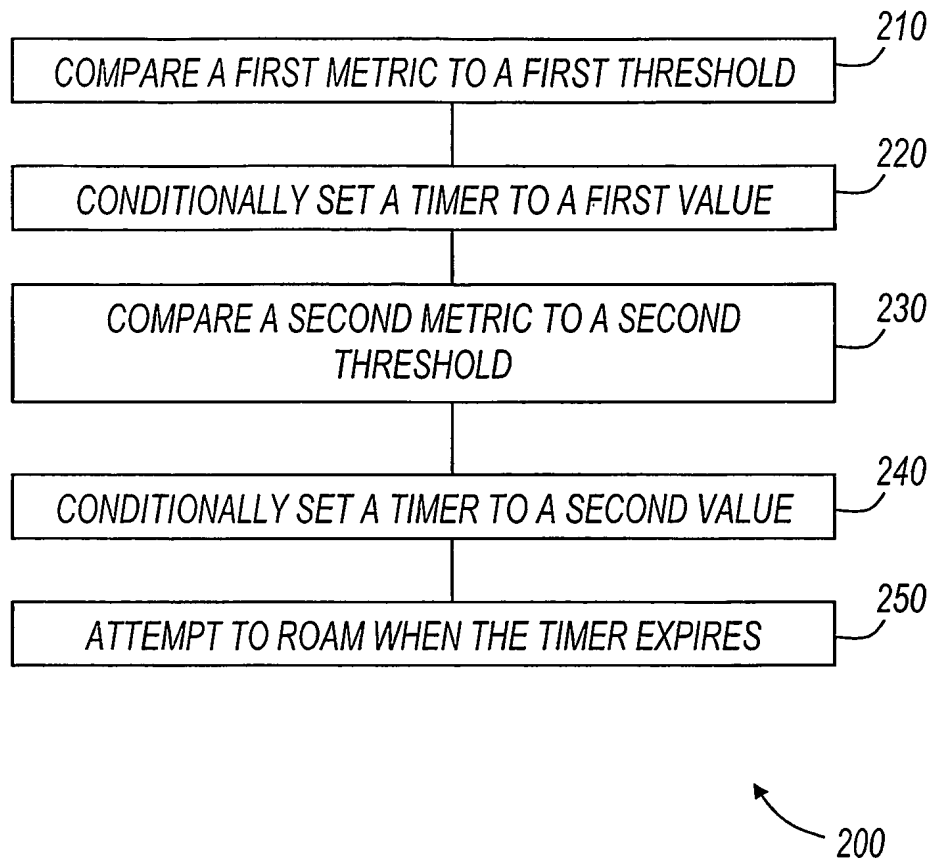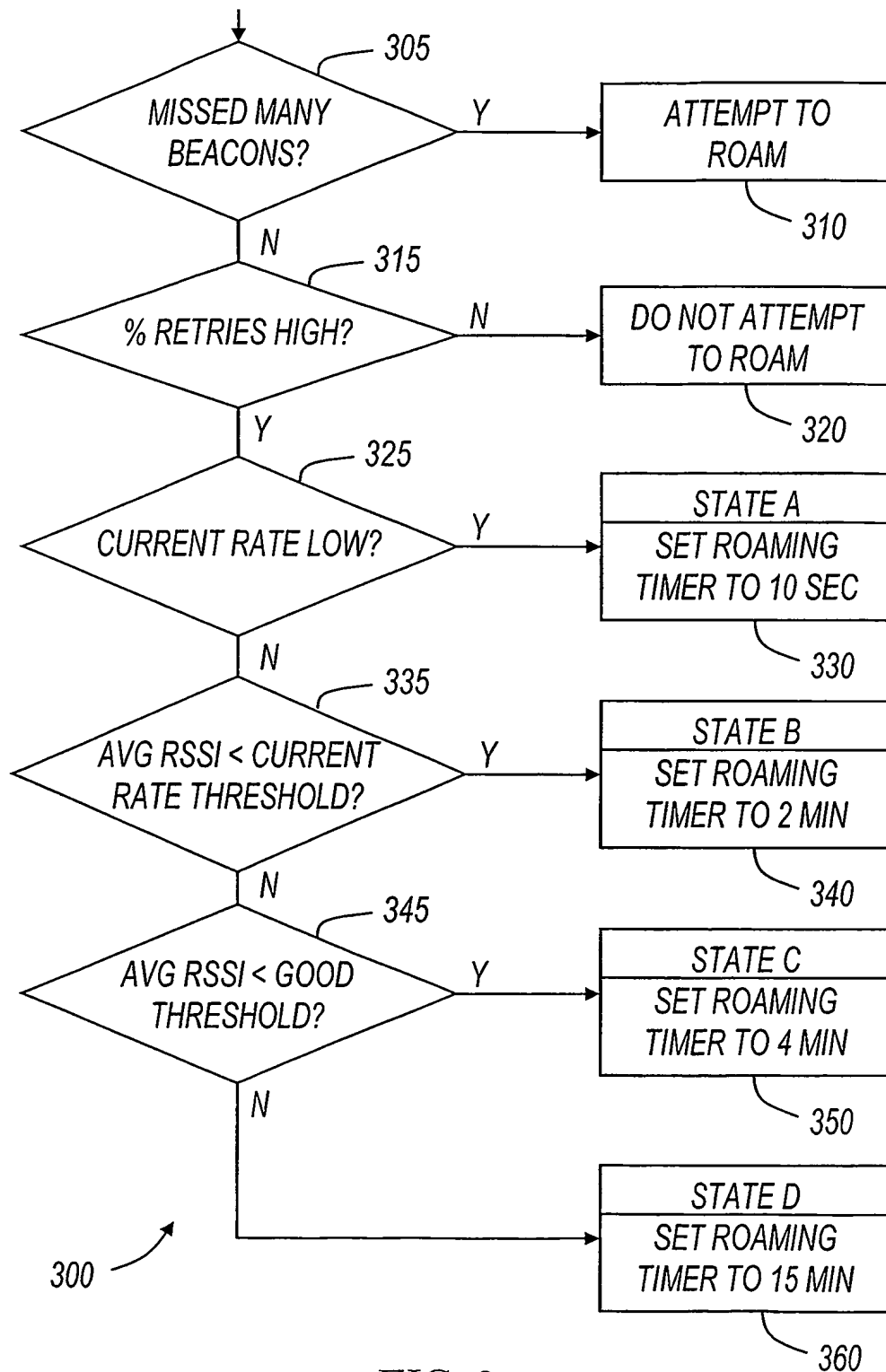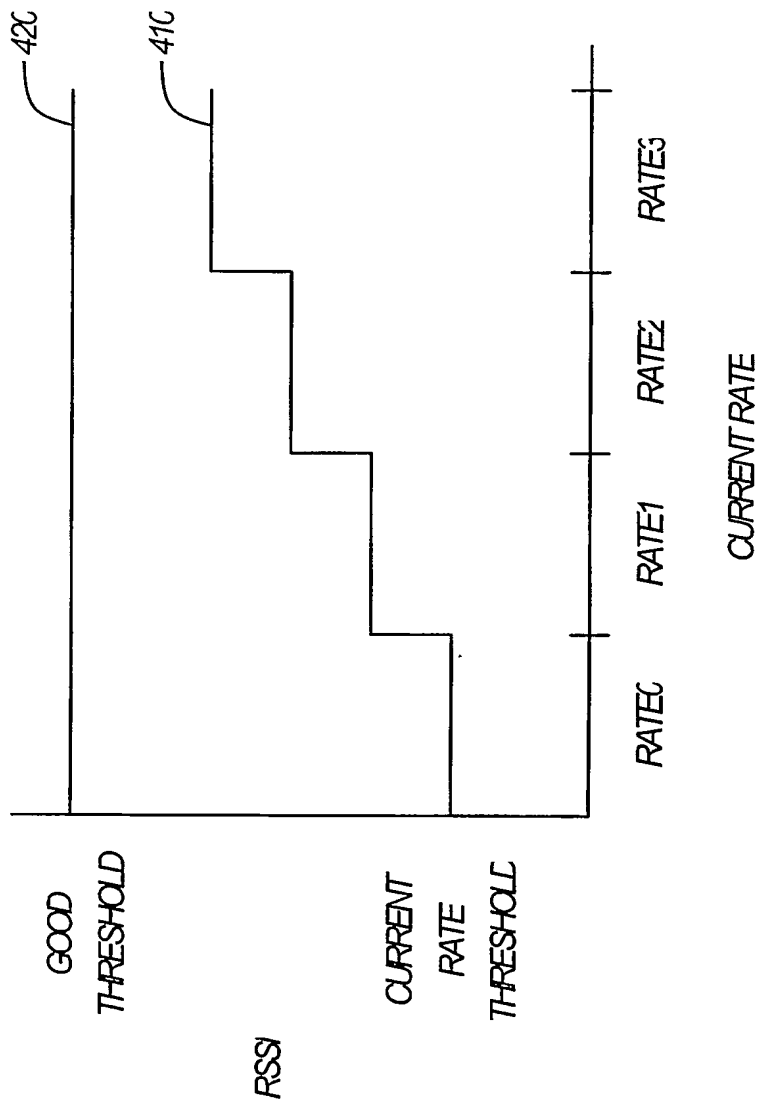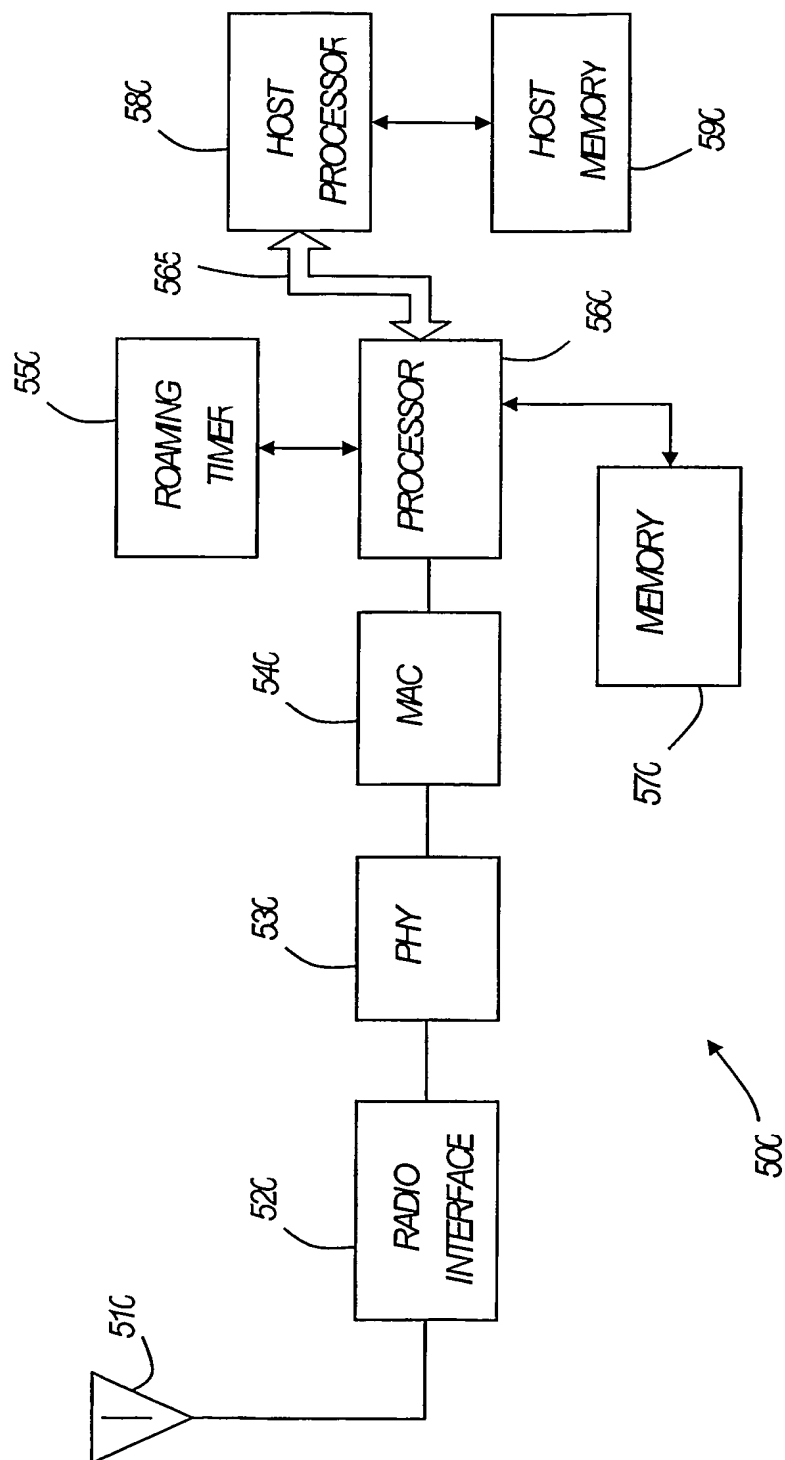
—200

FIG. 2

FIG. 3

FIG. 4

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **LEE D-J et al.** On Optimum Timer Value of Area and Timer-based Location Registration Scheme. *IEEE Communications Letters,* April 2001, vol. 5 (4), 148-150 **[0005]**